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7-10-2019

# Reducing CAUTIs in a Neurological ICU

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Reducing CAUTIS in a Neurological ICU

Doctor of Nursing Practice Project Presented to the  
Faculty of Graduate Studies  
University of Missouri – St. Louis

In Partial Fulfillment of the Requirements  
for the Degree of Doctor of Nursing Practice  
by

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August 2019

### Abstract

Catheter-associated urinary tract infections (CAUTIs) are the primary source of infection in patients with urinary catheters and are the fourth leading cause of healthcare-associated infection. Because indwelling urinary catheters are not completely avoidable in hospitalized patients, it is crucial to utilize evidence-based research to prevent CAUTIs. A urinary catheter maintenance bundle is one way to reduce CAUTI rates in hospitalized patients. This quality improvement project utilizes a catheter maintenance bundle with seven elements with the aim of reducing CAUTI rates. The project takes place in a 20-bed neurological intensive care unit (ICU) in a larger tertiary care medical center. Prior to initiating compliance to catheter maintenance care through audits, staff nurses in the ICU were educated on the hospital's infection prevention urinary catheter maintenance bundle that includes seven elements of catheter maintenance. These elements include red seal intact, bag and tubing off of the floor, bag below level of the bladder, urine flow without obstruction, thigh securement, individual collection container, and collection container that is labeled. There were 394 catheter maintenance bundle audits completed biweekly from February 2019 to May 2019. Increased compliance to the catheter maintenance bundle was achieved but did not result in a decrease in CAUTI rates.

### Reducing CAUTIs in a Neurological ICU

According to the Centers for Disease Control (CDC, 2018), urinary catheters are commonly used in hospital settings and are the fourth leading cause of healthcare-associated infection. Catheter-associated urinary tract infections (CAUTIs) are the primary source of infection in patients with urinary catheters (Cao, Gong, Shan, & Gao, 2018). CAUTIs result from bacteria or other microorganisms' ability to enter a patient's urinary tract through the indwelling catheter (CDC, 2010). The presence of bacteria can result in infection that is either symptomatic or asymptomatic.

Because indwelling urinary catheters (IUC) are not completely avoidable in hospitalized patients, it is crucial to utilize evidence-based research to prevent CAUTIs. Through implementation of evidence-based research findings, this project aims to reduce CAUTI rates within a neurological intensive care unit (ICU). A reduction in CAUTI rates is not a trivial outcome, as CAUTIs place patients at risk of "morbidity, mortality, healthcare costs, and length of stay" (CDC, 2010). This project aims to improve quality in healthcare provided through utilizing the Six Domains of Healthcare Quality from the Agency for Healthcare Research and Quality (2016) including safe, effective, patient-centered, timely, efficient, equitable care. Through reducing CAUTI rates in the neurological ICU, patients will benefit from safe care, or avoidance of harm, effective care based on scientific evidence, efficient care, meaning avoiding waste of equipment needed to run a urine analysis and culture as well as the need for antibiotics in treatment of a CAUTI. Lastly, reducing CAUTI rates provides equitable care that does not vary based on the individual patient. This project's outcomes have potential to impact the healthcare system in general. If a significant reduction in CAUTI rates is established, the

findings can be applied to other ICUs within the hospital, the hospital system, and potentially across the country, thus impacting the healthcare system at large.

According to the CDC (2018), 12%-16% of hospitalized adults will have a urinary catheter during their hospital stay with an increased risk of developing a CAUTI with each day that passes. A patient's CAUTI risk is increased in acute care settings with an incidence rate of 17.6% compared to 3-7% in non-acute care settings (Cao, Gong, Shan, & Gao, 2018). Many factors contribute to CAUTI development in hospitalized patients. For example, patients require monitoring of urinary output versus fluid intake resulting in prolonged indwelling catheter time. Knill, Maduro, and Payne (2018) investigated CAUTIs by indication and "discovered that most of the patients who developed infections had the catheter placed for urinary retention or strict intake and output." Patients in neurological ICUs are rarely sedated, resulting in spontaneous movement that can affect the cleanliness of the catheter. In comparison to the six other ICUs within the midwestern academic healthcare system, the neurological ICU has the second highest CAUTI rate in 2018 (Barnes-Jewish Hospital Infection Prevention, 2019). In 2018, the neurological ICU had 17 CAUTIs (Barnes-Jewish Hospital Infection Prevention, 2019). The neurological ICU's standardized infection ratio for CAUTIs is 0.92 which is higher than the benchmark of 0.6 (Barnes-Jewish Hospital Infection Prevention, 2019). This exemplifies the need for a quality improvement initiative that aims to reduce CAUTI rates.

Because of the Hospital-Acquired Conditions (HACs) Initiative of 2008, Medicare denies payment for patients that develop CAUTIs (Waters et al., 2015). CAUTIs are considered Never Events by the National Quality Forum meaning an error

“in medical care that are of concern to both the public and health care professionals and providers, clearly identifiable and measurable (and thus feasible to include in a reporting system), and of nature such that the risk of occurrence is significantly influenced by the policies and procedures of the health care organization” (Centers for Medicare & Medicaid Services, 2008). According to the Agency for Healthcare Research and Quality (2017), the estimated cost of a CAUTI ranges from \$4,694 to \$29,743. Although CAUTIs can be treated with antibiotics, it is a preventable infection through aseptic insertion and proper maintenance (CDC, 2010). This project aims to create practice improvement where evidence-based research is translated into practice with improved outcomes for each patient. Because evidence-research findings suggest utilizing a catheter maintenance bundle to reduce CAUTIs, this project hopes to educate each staff nurse about the catheter maintenance bundle and its importance. Without a solid foundation of catheter maintenance through the bundle within the ICU, future research on methods to reduce CAUTIs will not have transferable findings. With the goal of better patient outcomes and reduced hospital cost, many quality improvement initiatives have been implemented to reduce CAUTIs in hospital settings. This quality improvement project utilizes the seven aspects of the CAUTI maintenance bundle: maintaining a closed system, bag and tubing off of the floor, bag below the level of the bladder, urine flowing without obstruction, securement device in place, individual collection device, and collection device labeled with patient name.

This quality improvement project takes place in a neurological ICU in a large academic medical center in the Midwest. The ICU holds 20 beds with nurse to patient ratio of 1:2. At the time of this project’s initiation, monthly rounds were conducted by

Infection Prevention utilizing a urinary catheter maintenance observation tool. This tool assesses for seven aspects of the urinary catheter care bundle including if the system is closed, if bag and tubing are off of the floor, if urinary flow is obstructed, if the patient has an individual collection device, if the collection device is labeled, if the bag is below the level of the bladder, and presence of a securement device. In comparison to other bundles, the Institute for Healthcare Improvement (IHI, 2018) created a UTI compliance bundle available to the public. The IHI (2018) bundle includes that the catheter is secure and in a comfortable position for the patient, that the “foley bag <2/3 full and emptied prior to transport,” a closed system, that the bag is attached to the bed and below the level of the bladder, the bag and tubing do not touch the floor, and correct documentation (IHI, 2018).

In 2018, the neurological ICU has the poorest compliance in thigh securement (83.3%), with compliance rates above 93% in areas of bag below level of bladder, individual collection device, no obstruction to urinary flow, and closed system. Because of this deficit in compliance to the catheter maintenance bundle, this project aims to increase compliance through nurse education. The purpose of this quality improvement project is to investigate the effect of increased compliance to the urinary catheter maintenance bundle on CAUTI rates in the neurological ICU. The PICO question is as follows: In neurological ICU patients, what is the effect of increased compliance to the CAUTI maintenance bundle on CAUTI rates?

The literature review process was conducted using the databases CINHL, Scopus, and PubMed. Researchers used search terms including (neuro\* AND intensive care) AND (urinary catheter infection) AND (prevention). Other search terms used included

(thigh securement AND CAUTI) and (CAUTI bundle AND intensive care). The cutoff of 2007 was utilized for years searched. There were no exclusion criteria utilized in the search process. A basic google search was conducted to locate the Institute for Healthcare Improvement Catheter-Associated Urinary Tract Infection Guidelines as well as information from the CDC.

Upon gathering the literature, different themes emerged based on preventing CAUTIs in hospitalized patients. Aseptic insertion is referenced as a part of a proper urinary catheter insertion bundle (CDC, 2015). Although minor details vary between articles, findings suggest urinary insertion bundles include appropriate indication, hand hygiene and sterile equipment including sterile lubricant (Meddings, Rogers, Krein, Fakin, Olmsted, Saint, 2014; Hanchett, 2012).

Early catheter removal emerged as another theme in the literature. The risk of CAUTIs increase with each passing day of dwell time. Several articles investigated the effect of early catheter discontinuation on CAUTI rates (Richards et al., 2017; Halperin et al., 2016; Meddings et al., 2016). Mechanisms to enhance catheter discontinuation included “electronic hard-stop queries” in the software, nurse and physician education, and daily rounds to assess for need of urinary catheter (Kachare, Sanders, Myatt, Fitzgerald, & Zervos, 2014). Some articles suggest placing a label on the catheter tubing with date of placement and utilizing condom catheters (Meddings et al., 2014; Richards et al., 2017). Cleansing of the urethral meatus and urinary catheter is an important factor to lower CAUTI rates. Daily baths using chlorohexidine soap are recommended to prevent infection (Cao, Gong, Shan, Gao, 2018) while Halperin et al. (2016) recommend cleansing the catheter with soap and water every 12 hours. As aseptic technique is



important for insertion, the tubing should be kept clean in the maintenance of the catheter (IHI, 2011).

The concept of urinary catheter maintenance bundles emerged as the most prominent theme in the literature. A catheter maintenance bundle is defined as “the integrated and ideally synergistic effect of a group of straightforward, evidence-based practices” (Hanchett et al., 2012). According to Hanchett et al. (2012), the bundle serves as an important factor in preventing CAUTIs because it integrates consistent use of different elements while selective use of each element has lesser effect. In theory, the sum of the whole of the bundle is greater than implementation of the individual elements. Different bundle elements include daily assessment of catheter need, tamper evident seal intact, securement device, hand hygiene, daily meatal hygiene, drainage bag emptied with clean container, and unobstructed flow maintained (Hanchett et al., 2012). Another bundle found in the literature implemented a “closed drainage system, securement of drainage tubing to the patient’s thigh, drainage bag off the floor, drainage bag not overfilled, and drainage tubing not kinked” with statistical significance in reduction of CAUTI rates (Vacca & Angelos, 2013). A different study implemented a CAUTI bundle that included review of physician order for catheter every shift, daily assessment of need for catheter including contacting the provider if the catheter was no longer needed, “catheter care every 8 hours and as needed using water and liquid soap,” “hand hygiene, monitoring for kinks in catheter and tubing, securing IUC appropriately with a leg strap, maintaining integrity of seal between catheter and drainage bag tubing, and ensuring catheter bag is always at least 6 inches above the floor/below the patient’s bladder,” and “emptying catheter bag every 8 hours or when bag is two-thirds full” (Carr, Lacambra,

Naessens, Monteau, & Park, 2017). With the implementation of the bundle, the “unit achieved and sustained a CAUTI rate of 0 for 22 months with a 38% reduction of catheter days” (Carr, Lacambra, Naessens, Monteau & Park, 2017).

The Institute for Healthcare Improvement (IHI, 2011) published guidelines for catheter maintenance that suggest every catheter should “maintain a sterile, continuously closed drainage system,” and that the catheter should be “properly secured to prevent movement and urethral traction.” The Joint Commission (2016) suggests “securing catheter for unobstructed urine flow and drainage” as an element of proper catheter maintenance. These recommendations parallel the medical center’s urinary catheter maintenance bundle elements of red seal intact and the utilization of thigh securement. Other elements of catheter maintenance suggested by the IHI (2011) include ensuring urine flow is not obstructed, keeping “collection bag below the level of the bladder at all times,” and emptying “collection bag regularly, using a separate collecting container for each patient, and avoid allowing the draining spigot to touch the collecting container.” The medical center’s catheter maintenance bundle does not incorporate the draining spigot to touch the collection container as an element, nor does it have guidelines for emptying the bag regularly. In the neurological ICU in this project, the catheter bag is emptied every two hours.

### **Method**

The IHI tool, Plan-Do-Study-Act (PDSA) cycle, is used for this quality improvement project. The PDSA cycle allows for documenting change (IHI, 2017). The plan portion of the cycle includes identifying the problem and developing a plan to test the change including outcome data. Audit data from the BJH Neurological ICU identified

the issue of poor compliance rates of the bundle and high CAUTI rates. Staff nurses will be educated at the monthly staff meeting as well as one-on-one education. The catheter maintenance bundle tool utilized by the researcher is the same tool utilized by the hospital's infection prevention team. It assesses seven aspects of catheter maintenance: if the system is closed, if bag and tubing are off of the floor, if urinary flow is obstructed, if the patient has an individual collection device, if the collection device is labeled, if the bag is below the level of the bladder, and presence of a securement device. Auditing biweekly will allow for sooner identification of problems, 1:1 follow-up education and identification of unexpected problems (IHI, 2017). As audit results are obtained, the Study portion of the cycle calls comparison to initial findings. This will include findings from monthly audits and CAUTIs reported. With the study portion complete, the PDSA cycle calls for action where education adapts for the next PDSA cycle. During this portion of the cycle, areas of improvement and strategies to aid in reducing CAUTIs will be identified.

Administrative approval for the project was obtained in November of 2018 from the neurological ICU manager. The University of Missouri – St. Louis IRB and the Barnes-Jewish Hospital Research Review Committee approved the project as non-human subjects.

This project is a quality improvement design with a goal of improving compliance with the CAUTI maintenance bundle in an effort to reduce CAUTI rates in the neurological ICU in a large academic tertiary care hospital. The neurological ICU has 20 beds with a nurse to patient ratio of 1:2. The hospital is the largest hospital in the state and is the first adult hospital to be certified as a “Magnet Hospital” in the state (Barnes-

Jewish Hospital, n.d.). Education, coined “Back to Basics Bundle” was created for staff. The nursing staff was educated on the importance of compliance to the catheter maintenance bundle. This education was provided in unit monthly staff meetings, one-on-one education, and educational poster boards throughout the ICU. The one-on-one education included an explanation of the quality improvement project, the effect of bundling care, and how maintenance is different from catheter care or cleansing. Each of the seven elements were explained during this education and any of the staff’s questions were answered. Visual education included poster boards utilizing themes that were updated monthly. For example, February utilized a Valentine’s Day theme poster, heart shaped valentines posted on computers in each patient room, and fliers in the restroom and breakroom.

Each nurse was educated in a one-on-one fashion with the researcher. Each month, the researcher created an educational poster with eye-catching visuals to help educate nursing staff. Changing the theme kept the information fresh and provided an opportunity for any necessary updates. Real-time feedback with positive reinforcement or education occurred with every audit. After completing the patient audit, the nurse was educated on which of the 7 elements were compliant or noncompliant and ways to increase compliance.

Biweekly compliance rounds began in February 1, 2019 and ended in May 31, 2019. The researcher used the catheter maintenance audit tool provided by the hospital’s infection prevention team. The audits were completed by one observer. If the patient’s catheter did not meet the expectations of the maintenance bundle, the nurse was provided education regarding the areas not meeting standard. All nursing staff was provided with

positive reinforcement including candy and verbal recognition at the time of audits. The hospital's infection prevention monthly report was used to measure CAUTIs each month.

The sample included patients in the neurological ICU with an indwelling urinary catheter. Patient audit information was deidentified including name, age, sex, and race. There were 394 audits completed over a four-month period.

Data was de-identified using the patient's assigned location and nothing else. There were no patient identifiers within the data which were evaluated in aggregate. At the completion of each audit day, the data was coded as compliance rates in an excel spreadsheet and analyzed with SPSS version 25. A copy of the Urinary Catheter Maintenance Observation Tool is provided in appendix A. CAUTI results are published monthly by the hospital's infection prevention team and were used as an outcome in this project.

To test for a trend over time in the percent compliance, the Kruskal-Wallis one-way analysis of variance was used after the test of homogeneity of variances was statistically significant. To examine the trend over time more closely, post hoc pairwise comparisons using the Dunn-Bonferroni method were used to test pairwise differences in median monthly percent compliance across month observed.

Prior to initiating this project, 2 separate audits were completed on the catheter maintenance bundle prior to identifying areas of weakness within bundle compliance. Findings of these audits suggested that less than 50% of patients with urinary catheters had catheter tubing appropriately secured to the thigh and 80% of bag and tubing were off of the floor. This reflects the findings provided by the hospital's infection prevention

that found an 83% thigh securement compliance and 99% bag and tubing off floor compliance rate in this ICU.

### **Results**

There were 394 audits completed over 36 days. The date is reported as a mean  $\pm$  standard deviation. The overall bundle mean compliance was 0.61 ( $\pm 0.49$ ). Each maintenance bundle element compliance was evaluated. Of the seven elements, red seal intact had a mean compliance rate of 97.2 ( $\pm 1.7$ ). The 2.8% of non-intact red seal is associated with catheters that medically required a break in the seal related to coude catheters or catheters placed by Urology. The element of bag and tubing off of the floor had a mean compliance rate of 94.4 ( $\pm 0.23$ ). This element could potentially be dependent upon time of the audit, where patients in the chair may be more likely to have tubing that touches the floor. Urine flowing without obstruction had the lowest mean compliance rate of 76.9 ( $\pm 0.42$ ). The mean compliance of individual collection container was 99 ( $\pm 0.10$ ) with labeled collection container 93.1 ( $\pm 0.25$ ). The mean compliance of bag below the bladder was 99.7 ( $\pm 0.05$ ). Thigh securement mean compliance was 85.5 ( $\pm 0.35$ ).

The percent compliance was calculated by day and by month. Daily percent compliance ranged from 42.86% to 100% with a mean of 92.27 ( $\pm 11.07$ ). Monthly percent compliance ranged from 87.55% to 97.39 with a mean of 92.24 ( $\pm 11$ ). While variance was noted daily, there was a trend of improved bundle compliance over time. There was an overall statistically significant trend over time in percent compliance ( $p < 0.001$ ). While there was no statistically significant comparison between February percent compliance and March percent compliance ( $p=0.467$ ) or April percent compliance and May percent compliance ( $p=0.159$ ), based on the post hoc pairwise comparisons, May

percent compliance was significantly higher than February ( $p < 0.001$ ) and April percent compliance was significantly higher than March ( $p = 0.007$ ). Over the four months of the quality improvement implementation, there were four CAUTIs in the ICU. There were two CAUTIs in March and two in May. Due to the quality improvement nature of this project, individual patient compliance data was not evaluated. Therefore, specific compliance and CAUTI comparisons cannot be made.

### **Discussion**

Although no difference in CAUTI rates can be made, there was an increase in compliance to the bundle over time. Continued staff education and reinforcement of the 7 elements of catheter maintenance likely aided in compliance rates over time. The staff nurses were receptive to the education and overall found the education was helpful. While the staff nurses are educated on how to sterilely place a catheter and complete catheter care, catheter maintenance is rarely a point of education. Many of the nurses voiced that they had never had formal education on how to maintain a catheter, including how to use the clips provided on the tubing to reduce dependent loops. The increase in compliance to the bundle has resulted in a practice change for new nurse orientation in the ICU. In addition to education on sterile insertion, early removal, and catheter care, nurses will be educated on the seven elements of the catheter maintenance bundle.

As a bundle, the best effort to reduce CAUTI rates is through compliance in all seven elements. Assessing the compliance rates of each of the elements allows to identify areas of weakness in the bundle where additional education should be targeted. Throughout the implementation phase, fliers and posters were utilized to educate staff on elements with lower compliance rates. For example, a small visual reminder was posted

on every computer in each patient room to increase compliance to urine flowing without obstruction. A flier with a photograph of a dependent loop was posted in the staff restroom asking, “what is wrong with this picture?” to serve as a reminder to allow urine to flow without obstruction.

The urinary catheter maintenance bundle represents one key aspect of reducing CAUTIs. However, the other elements of CAUTI reduction were not addressed in this project. The quality improvement nature of this study did not allow compliance data to be paired with specific patient information. Neither the number of CAUTI days per patient nor the known compliance of each day was recorded. This quality improvement project took random snapshots of catheter maintenance but did not collect daily information. Therefore, compliance at one moment in time does not reflect compliance throughout a nurse’s shift or through the entirety of a patient’s ICU stay.

This quality improvement project reflects a need for reeducation of nursing staff on basic catheter maintenance. Future studies should assess for effects of education on staff nurse compliance rates. For example, understanding the knowledge base of staff nurses on catheter maintenance before implementing maintenance education could be helpful in increasing compliance.



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